NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WETLAND RESTORATION

(Acre)

CODE 657

DEFINITION

The rehabilitation of a degraded wetland or the reestablishment of a wetland so that the soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.

PURPOSE

To restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance by:

- Restoring hydric soils.
- Restoring hydrology (depth, duration, and season of inundation, and/or duration and season of soil saturation).
- Restoring native vegetation (including the removal of undesired species and/or seeding or planting of desired species).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to sites with hydric soils that were natural wetlands previously degraded hydrologically and/or vegetatively.

When restoration is complete, the site will meet the current NRCS soil, hydrology, and vegetation criteria of a wetland.

This practice is applicable if natural hydrologic conditions can be approximated by modifying drainage and/or artificial flooding of a duration and frequency similar to natural conditions or where wetland plant communities can be restored under an existing natural hydrologic condition.

This practice does not apply to a Constructed Wetland (656) intended to treat point and non-point sources of water pollution; Wetland Enhancement (659) intended to rehabilitate a degraded wetland, where specific functions and/or values are enhanced beyond original conditions; or Wetland Creation (658) for creating a wetland on a site location that historically was not a wetland.

CRITERIA

General Criteria

The purpose, goals, and objectives of the restoration shall be clearly outlined, including soils, hydrology, and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

The soil, hydrology, and vegetative characteristics existing on the site and the contributing watershed shall be documented before restoration of the site begins.

Upon completion of restoration, the site shall meet soil, hydrology, vegetation, and habitat conditions of the wetland that previously existed on the site to the extent practicable, and meet the criteria applicable to the definition of a wetland as described in the NRCS National Food Security Act Manual.

Where off-site drainage or the presence of invasive species impact the site, the design shall compensate for these landscape changes (e.g., increased water depth, berms, or microtopography).

Invasive species, Federal/State listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site. This includes planning for the ability to manipulate water levels to control unwanted vegetation, if necessary. The establishment and/or use of non-native plant species shall be discouraged where possible.

The landowner shall obtain necessary local, State, and Federal permits that apply before restoration. Wetland restoration activities, including those associated with existing wetlands and streams, are subject to:

- Clean Water Act (Nationwide/404 Permit/401 certification).
- Tennessee Water Pollution Control Act (ARAP permit).
- Tennessee Valley Authority Act (Section 26A Permit), if in the Tennessee River Watershed.

Water rights shall be assured prior to restoration, if required.

Vegetative buffers shall be established on surrounding uplands, when necessary, to reduce the movement of sediment, soluble contaminants, and sediment-attached substances carried by runoff.

If the presence of hazardous waste materials in the sediment or fill is suspected, soil samples will be collected and analyzed as defined by local, State, or Federal authorities. Sites containing hazardous waste will not be restored under this standard.

Criteria for Hydric Soil Conditions

Restoration sites will be located on hydric soils or on problem soil areas that are hydric.

If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall be removed only to the surface of the buried (or original) hydric soil. This material shall be safely disposed of in a manner that prevents deposition back over the hydric soil area (e.g., down-slope stockpiling and vegetating the material or hauling to an upland site).

Reestablish an approximation of the original soil macrotopography. All excavated material shall be placed in a manner to prevent surface water contamination and vegetated, if appropriate.

Criteria for Hydrology Restoration

General Hydrology Criteria

A natural source of water shall be used to reestablish the site's hydrology that approximates the needs of the wetland type. If this is not possible, an artificial water supply can be used; however, these sources shall not be diverted from other wetland resources (i.e., springs). The hydrology of the site is defined as the rate, path, and timing of inflow and outflow and the duration, frequency, and depth of flooding, ponding, or saturation. Sources of water include direct rainfall, runoff, floodwater, interflow, and ground water discharges.

Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose. Existing drainage systems that serve as outlets for other properties shall be modified only to the extent that outlet adequacy for those properties is maintained. The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement, or permit.

To the extent technically feasible, topographic relief and/or microtopography will be reestablished. Reference sites within the area and historical maps and documents should be utilized to determine desired topographic relief.

The maximum hydrology and overall hydraulic variability of the restored site will approximate the conditions that existed before alteration (e.g., dynamic and static water levels, soil saturation). In order to achieve the level of hydrology restoration consistent with pre-conversion condition, one or more of the following treatments will generally be required:

1. **Surface Drainage Removal**
   - Embankment (Levee) Construction
   - Ditch Plug
2. **Subsurface Drainage Removal**
   - Tile Break
3. **Levee Breach**
4. **Shallow Excavation**

All disturbed areas associated with structural measures or excavation shall be revegetated immediately after the construction period in accordance with the Critical Area Planting standard (Code 342). Native plant materials shall be utilized to maximize wildlife benefits for those features not subject to significant scouring or erosion (e.g., nesting islands).

When desirable to manipulate water levels different from the planned hydrologic restoration (e.g., waterfowl management), a device meeting the standard Structure for Water Control (Code 587) shall be used.

The standards and specifications for Dike (Code 356) and Structure for Water Control (Code 587) will be used as appropriate. Refer to the National Engineering Handbook, Chapter 13, "Wetland Restoration, Enhancement, and Creation," and Chapter 6, "Structures," for additional design information.

Embankment (Levee)

Levees constructed to create pool storage or designed to restore seasonal flooding within channelized floodplains shall have an effective design height less than 6 feet

and meet the criteria for Dike (Code 356). The design height shall not exceed the minimum height needed to meet the planned water level plus freeboard in order to maintain floodplain integrity consistent with Executive Order 11988.

Borrow ditches shall be located on the inside or field side of the levee and not connect to existing field ditches.

Ditch Plug

Ditch plugs (earthen) designed to fill the channel shall be a minimum of 50 linear channel feet for soils with a hydraulic conductivity of less than 0.6 inches per hour, 100 feet for soils with 0.6 to 2.0 inches per hour, and 150 feet for greater than 2.0 inches per hour. Fill shall be compacted and crowned a minimum of 1.0 foot above the top of the lowest existing channel bank. A trickle tube (pipe) shall be installed with the plug when perennial base flows must be passed.

Ditch plugs designed to block the channel shall be installed perpendicular with a minimum of 20 feet of levee extending from each channel bank. Fill shall be compacted and crowned a minimum of 1.0 foot above the top of the lowest channel bank. Top width shall be a minimum of 4 feet. Side slopes shall be a minimum of 2:1 for clay and clay loam soils and a minimum of 4:1 for silt loams. One or both ends of the plug shall be feathered to natural ground as a spillway that safely routes floodwaters around the structure. Spillways shall be designed at stable velocities in a manner that allows for the safe re-entry of flows back into the downstream channel. A trickle tube (pipe) shall be installed through the structure, when perennial base flows must be passed.

Tile Break

When subsurface tiles are to be removed, either the entire system shall be treated by deep ripping or a minimum of 50 feet of each line removed near the outlet with the trench backfilled and compacted.

Levee Breach

Levee breaches shall be designed in a manner to restore floodplain integrity. Breach widths shall be a minimum of 200 feet. Breaches shall be located in low areas of a field, such as swales and stream meander scars. When breaches are planned, a minimum of two shall be installed on the site.

Levee spoil shall be safely disposed of in a manner that prevents entry into surface waters. Disposal may consist of placement in old borrow areas, stockpiling on remaining levees, hauled from the site, or spread evenly on non-hydric soils in a manner that does not impact the hydrology of the site.

Shallow Excavation

Shallow excavation shall be designed to restore macrotopography otherwise eliminated due to land leveling and other smoothing practices. In most floodplains, ridge and swale patterns consistent with relic meander scars or irregularly contoured patterns will best restore natural relief.

Excavated areas shall vary in width and depth, with an average depth of 6 to 18 inches over at least 75 percent of the area. The maximum depth shall not exceed 4 feet.

Spoil material shall be disposed of in a manner that prevents deposition into the shallow water area or adjacent waters. Spoil material utilized as nesting islands or floodplain ridges shall not exceed 4 feet in height, with 6:1 or flatter side slopes.

Criteria for Vegetation Restoration

The vegetation shall be restored as close to the original natural plant community as the restored site conditions will allow. Determination of the original plant community's species and percent composition shall be based on reference wetlands of the type being restored or technical reference listed in this standard that provides adaptive plant lists based on soil type, hydrologic condition (landscape position), and flood tolerance of the species.

Preference shall be given to native wetland plants with localized genetic material. Plant materials collected or grown from material collected within a 200-mile radius from the site is considered local.

In soils where seedbanks realistically exist or where natural colonization of selected native species (identified from reference wetlands) will dominate within five years, natural regeneration will be allowed. If the site has not become dominated by desired species within five years, active forms of re-vegetation may be required. For herbaceous plant communities, all hydric soils in the state have adequate seedbanks for colonization.

Natural regeneration of trees shall be allowed on sites planned for light-seeded species and under the following conditions: (1) the afforestation area is within 60 meters (197 feet) of mature hardwoods; or (2) the area is subject to frequent flooding with an upstream seed source for hydrochory.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the design.

On sites that were predominantly herbaceous vegetation prior to modification and planting and/or seeding is necessary, the minimum number of native species to be established shall be based on the number of ecological sites present. Sites restored to only one ecological site shall be established with at least three species adapted to the site. Sites with two or more ecological sites (i.e., wet meadow, shallow marsh, or slough eco-sites, etc.) shall be established with at least two native species on each ecological site.

Herbaceous vegetation, when planned, shall be established by an approved method, which may include mechanical or aerial seeding, topsoiling, organic mat placement, wetland sod, vegetative sprigs, wetland hay, etc., over the entire site or a portion of the site and at appropriate densities and depths.

Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a minimum of six (6) species. Forested wetland plantings and/or seeding will include a minimum of three (3) tree and/or shrub species on each ecological site (i.e., low flat, bottom ridge eco-sites, etc.) when natural regeneration will account for at least three additional species. Tree and shrub planting will follow the criteria of conservation practice Code 612, Tree/Shrub Establishment. Site preparation for the establishment of trees

and shrubs shall follow the Forest Site Preparation standard (490).

Afforestation with trees will be at the minimum rate of 302 seedlings per acre (12' x 12'spacing) for one-year-old bare root seedlings. The minimum allowable planting rate shall be 108 seedlings per acre (20' x 20' spacing) for advanced bare root seedlings, acceptable only in areas where colonization by light seeded species is anticipated.

Afforestation with shrubs shall be at the minimum rate of 680 seedlings per acre (8' x 8' spacing) for one-year-old bare root seedlings.

An adequate stand for planned afforestation shall be determined based on the minimum of (1) a 60 percent stem survival of planted seedlings/cuttings per acre, or (2) 150 stems per acre of natural colonization at the end of the second growing season. An adequate stand for planned establishment of native herbaceous vegetation shall be a minimum 80 percent ground cover.

Criteria for Wetland Functions

When functional recovery must be documented (i.e., for a permitting action or project activity):

- A functional assessment (Hydrogeomorphic Approach or similar method) shall be performed on the site prior to restoration. The Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Low-Gradient Riverine Wetlands in Western Tennessee shall be the accepted functional assessment for restoring riverine wetlands. The functional assessment methodology found in the National Food Security Act Manual shall be the accepted methodology for the restoration of non-riverine wetlands.

- Restoration goals and objectives shall include targeted natural wetland functions for the wetland type and site location, as determined by the functional assessment or reference site data.

- A post-project assessment will be performed after an adequate period (generally one-two growing seasons after establishment) to assess the success of the restoration. The assessment shall include as a minimum (1) an evaluation of the targeted hydrologic condition under normal climatic conditions based on the engineering design, if applicable; (2) an adequate stand determination for planned plant communities; and (3) documentation of any damages resulting from off-site influences. The Wetland Reserve Program "Tennessee On-site Evaluation Form" may be used to document the post-project assessment of the wetland restoration.

CONSIDERATIONS

Consider reviewing several sources of information to determine the historic hydrologic condition of the site, including soil surveys, drainage records, aerial photographs, landowner and local resident knowledge, historical documents, plan files, and current site conditions.

When restoring meanders and swales by shallow excavation in areas subject to significant flood flows, spoil material should be placed on the sides with the

upslope and downslope ends remaining open to the direction of flow. For depressions designed to hold water, spoil should be utilized as nesting islands or placed to form undulating mounds (circular) or ridges (linear) in a manner that stabilizes and immobilizes the soil material.

When constructing levees in floodplains, consider increasing both the front and back slopes in proportion to the anticipated flood stage. In high flood stage areas, slopes from 10:1 to as high as 20:1 will increase stability and lower maintenance. Damage to levees is reduced when the entire levee is submerged uniformly and has flatter slopes.

Consider effect of volumes and rates of runoff, infiltration, evaporation, and transpiration on the water budget.

Evaluate the potential for a change in rates of plant growth and transpiration because of changes in the volume of available soil water.

Consider effects on downstream flows or aquifers that would affect other water uses or users.

Consider effects on other wetlands or water-related resources and wildlife habitats that would be associated with the practice.

Consider as a high priority those sites adjacent to existing wetlands as they increase wetland system complexity and diversity, decrease habitat fragmentation, and ensure colonization of the site by wetland flora and fauna.

Consider linking wetlands by corridors wherever appropriate to enhance the wetland's use and colonization by the flora and fauna.

The nutrient and pesticide tolerance of the plant species planned should be considered, where known nutrient and pesticide contamination exists.

Consider effects of temperature on water resources to prevent undesired effects on aquatic and wildlife communities.

For discharge wetlands, consider upslope water/ground water source availability.

On sites where woody vegetation will dominate, consider adding one to two dead snags, tree stumps, or logs per acre to provide structure and cover for wildlife and a carbon source for food chain support.

Consider impact that water surface drawdowns will have on concentrating aquatic species such as turtles into diminished pool areas resulting in increased mortality.

Consider existing wetland functions and/or values that may be adversely impacted.

Consider the effect restoration will have on disease vectors such as mosquitoes.

Consider the effect of water control structures on the ability of fish or other aquatic species to move in and out of the wetland.

Consider the effects of soil disturbance and probability of invasion by unwanted species.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications shall

be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other documentation. Requirements for the operation and maintenance of the practice shall be incorporated into site specifications. Plans and specifications should be reviewed by staff with appropriate training in design and implementation of wetland restoration.

OPERATION AND MAINTENANCE

The following actions shall be carried out to ensure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use (operation) and repair and upkeep (maintenance) of the practice:

- Use of fertilizers, mechanical treatments, prescribed burning, pesticides, and other chemicals to assure the wetland restoration function performed in a manner that protects the intended purpose.

- Biological control of undesirable plant species and pests (e.g., using predator or parasitic species) implemented where available and feasible.

- Timing and level setting of water control structures required for the establishment of desired hydrologic conditions, hydro period, or management of vegetation.

- Inspection schedule for embankments and structures for damage assessment.

- Depth of sediment accumulation to be allowed before removal is required.

- Management needed to maintain vegetation, including control of unwanted vegetation. The control of water depth and duration may be utilized to control unwanted vegetation.

- For wildlife purposes, haying and grazing, if justified as a necessary wildlife/wetland management tool, used for management of vegetation. Livestock exclusion will be required for newly established woody plants.

- Avoidance of flap gates or other blocking devices on the outlet ends of water control structures within floodplains in order to maintain floodplain integrity.

- Installation of beaver exclusion devices such as the Beaver Deceiver, Beaver Baffler, or Clemson leveler, when necessary.

COMPLEMENTARY PRACTICES

Dike (356)
Structure for Water Control (587)
Shallow Water Management for Wildlife (646)
Fence (382)
Wetland Wildlife Habitat Management (644)
Critical Area Planting (342)
Tree/Shrub Establishment (612)
Forest Site Preparation (490)

GLOSSARY OF TERMS

Afforestation – The establishment of trees and shrubs by means of planting seed, seedlings, or cuttings.

Hydrochory - Seed dispersal by water.

Hydrogeomorphic Approach - Wetland classification system based on hydrology and landscape position.

Interflow - The lateral movement of water in the soil's unsaturated zone during and immediately after a precipitation event.

Macrotopography - Significant variation in relief resulting in alternating deeper water habitat intermixed with some upland characteristics. Macrotopography is typically created with earth-moving equipment, while microtopography is typically created with farm tillage equipment.

Riverine Wetland – Wetland occurring in floodplains and riparian corridors in association with stream channels, where the dominant water source is from overbank flow from the channel or subsurface hydraulic connection between the channel and wetland.

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